TECHNICAL
MANUAL

TM75-03-10R3-76

CTEC CALIBRATION CENTER

ANTENNA SIMULATOR

VHF - P/N 400041-20

UHF - P/N 400038-92

servo corporation of america

servo

111 new south road
hicksville, new york 11802
516-938-9700

"INFORMATION SYSTEMS FOR EFFICIENCY AND SAFETY"

28

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Effective 1 January 1970

Servo Corporation of America
Hicksville, New York

ANTENNA SIMULATOR

GENERAL

A direction finder system is subject to periodic preventive maintenance and occasional repair after a system malfunction, however rare.

To best troubleshoot or qualitatively assess the performance of a direction finder the most desirable approach is to illuminate the DF antenna with a live transmission and then signal trace through the complete system. While this approach has great merit it does impose some severe problems: a continuous on-the-air signal will interfere with normal communications, a target antenna external to the area of maintenance is required and siting conditions will influence to some degree the performance of the system thereby obscuring the true instrumental performance.

An alternate and more desireable approach is to utilize an antenna simulator which will reproduce and make available to the radio receiver input signals similar to those supplied by the DF antenna array. A block diagram of a test set-up using a simulator is shown in figure 1.

TECHNICAL DESCRIPTION

In normal system operation the circularly disposed antenna elements of the DF antenna are sequentially scanned thus measuring the instantaneous carrier phase of a received signal at each antenna. The phase steps measured between adjacent antennas is a function of their position relative to the equiphase front of a signal propagating across the array.

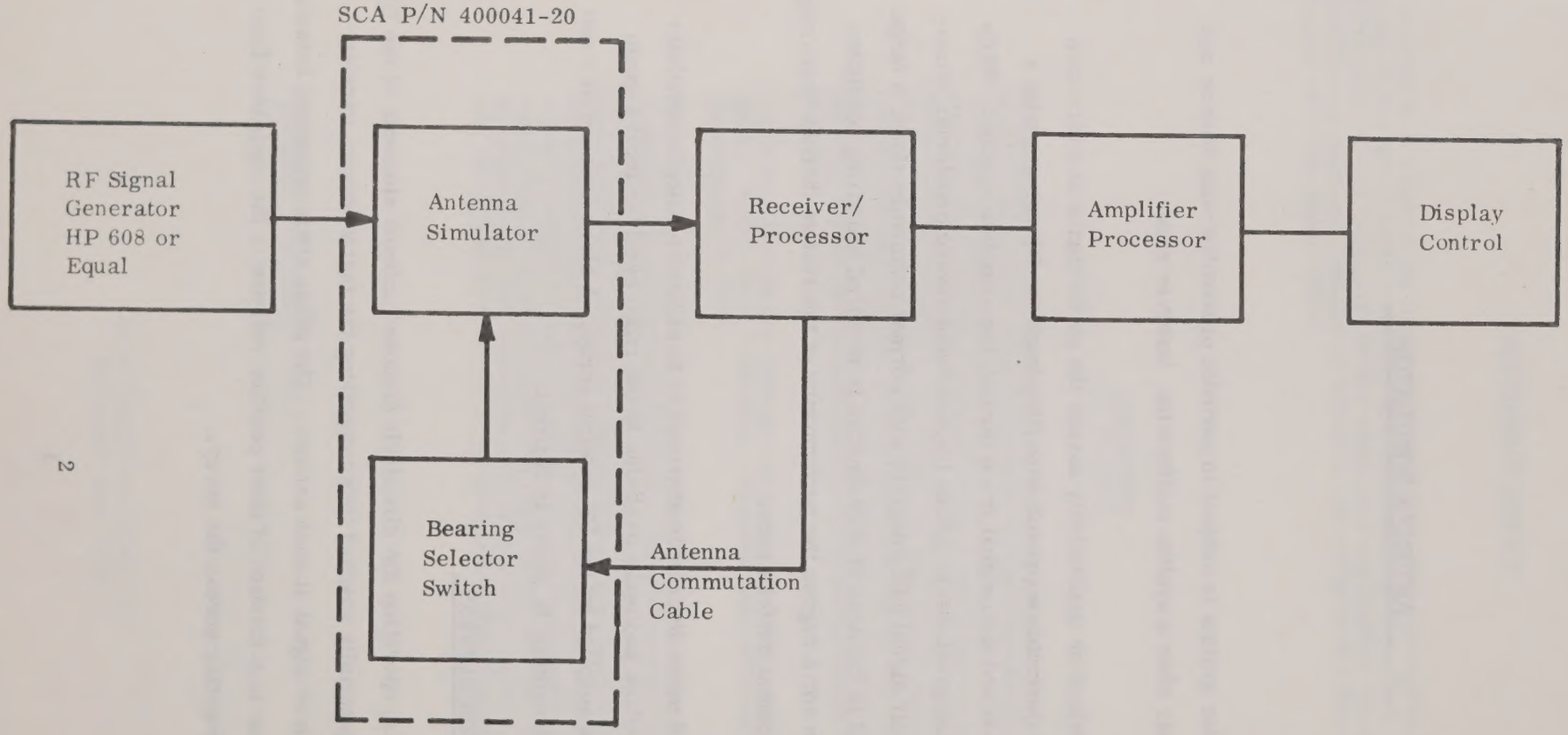

Figure 1. Block Diagram Employing Antenna Simulator

This phenomenon may be simulated by using delay lines cut to an electrical length equal to the spacing of the antenna array, providing a common RF feed to all the delay lines, and scanning the delay lines in a manner similar to the actual scanning of an antenna. The physical length of the delay lines differs from the actual antenna spacing by the propagation factor of the dielectric constant of the delay line, i.e., for RG-58/U cable the velocity of propagation is approximately 0.6 of free space. Figure 2 is a simplified schematic of a simulator.

Such a device when excited at an appropriate frequency to which the radio receiver is tuned will cause a simulated bearing to be displayed on the DF display unit. However, in order to check the accuracy of the system through 360^{o} azimuth in increments of 22.5^{o} corresponding to each antenna element a stepper switch is added. This switch causes the sampling pulses applied to the commutator to advance in increments of 22.5 degrees. In other words, the sampling pulse normally applied to the delay line corresponding to North antenna is advanced to the delay line representing the azimuthal direction of 22.5 degrees. Correspondingly, all other sampling pulses are similarly advanced. Rotating the bearing selector switch through its 16 positions will therefore cause the displayed bearing to be shifted in steps of 22.5 degrees, thus checking the overall accuracy of the system.

The diodes in the Antenna Simulator (CR1 - CR16) are normally back biased thus preventing conduction. When a positive pulse is applied to a diode, conduction takes place and the RF signal from the selected delay line is applied to the receiver. Sequential pulsing of the diodes therefore accurately simulates the phase samples of a received signal normally obtained from the antenna array. A complete schematic showing several typical lines to the stepper switch is shown in figure 3. Figure 4 is a complete wiring diagram of the stepper switch.

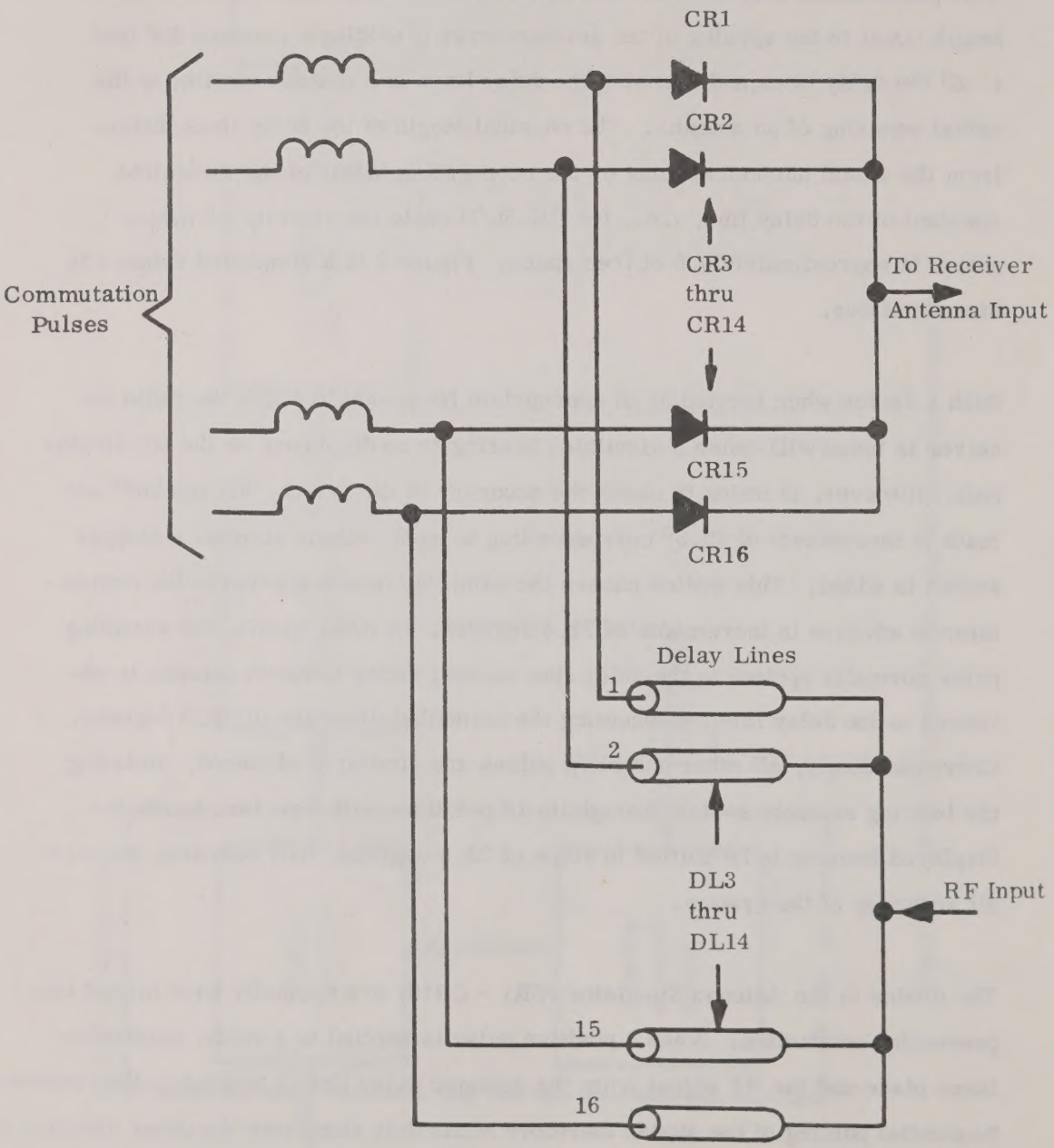

Figure 2. Simplified Antenna Simulator

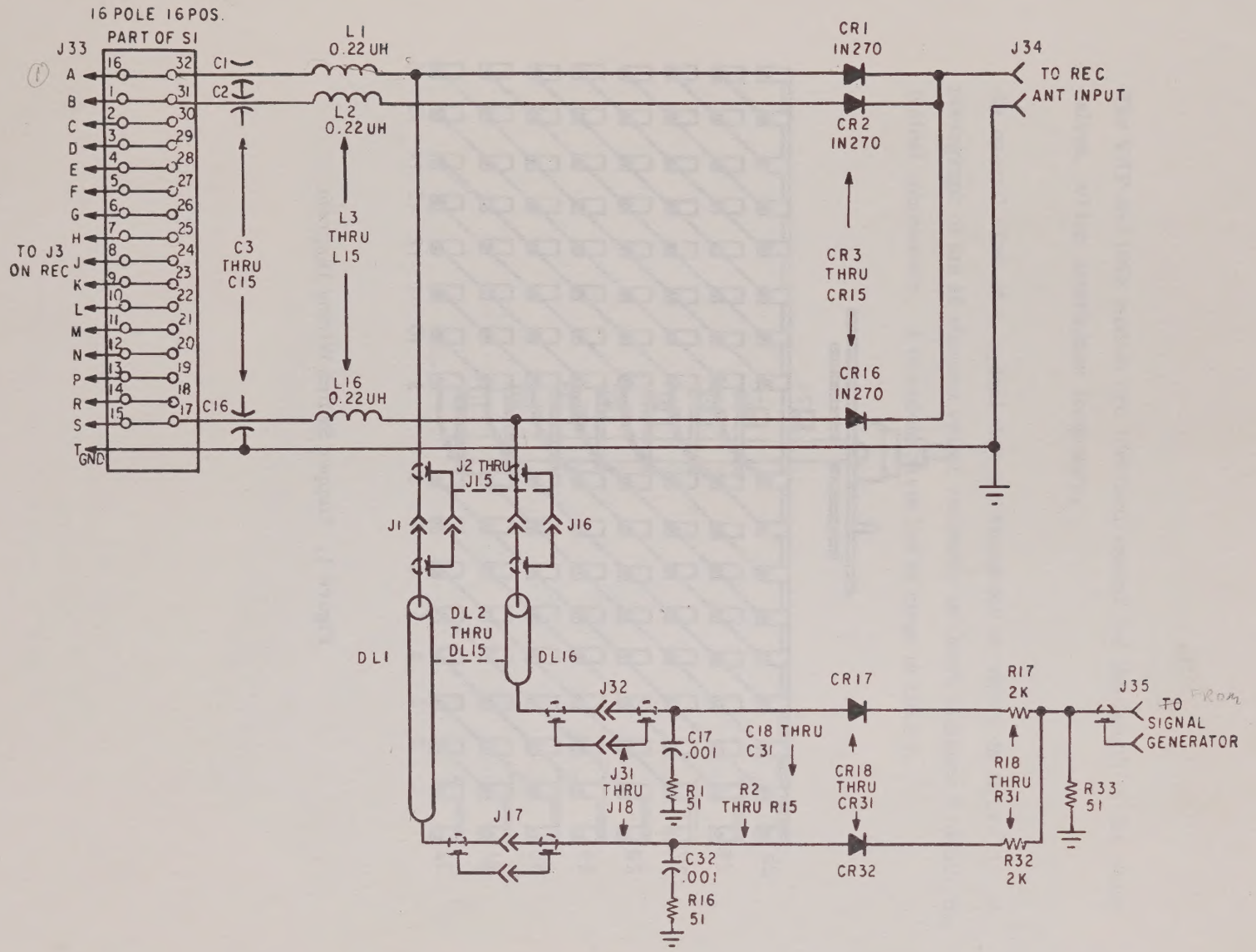

Figure 3. Antenna Simulator, Schematic Diagram

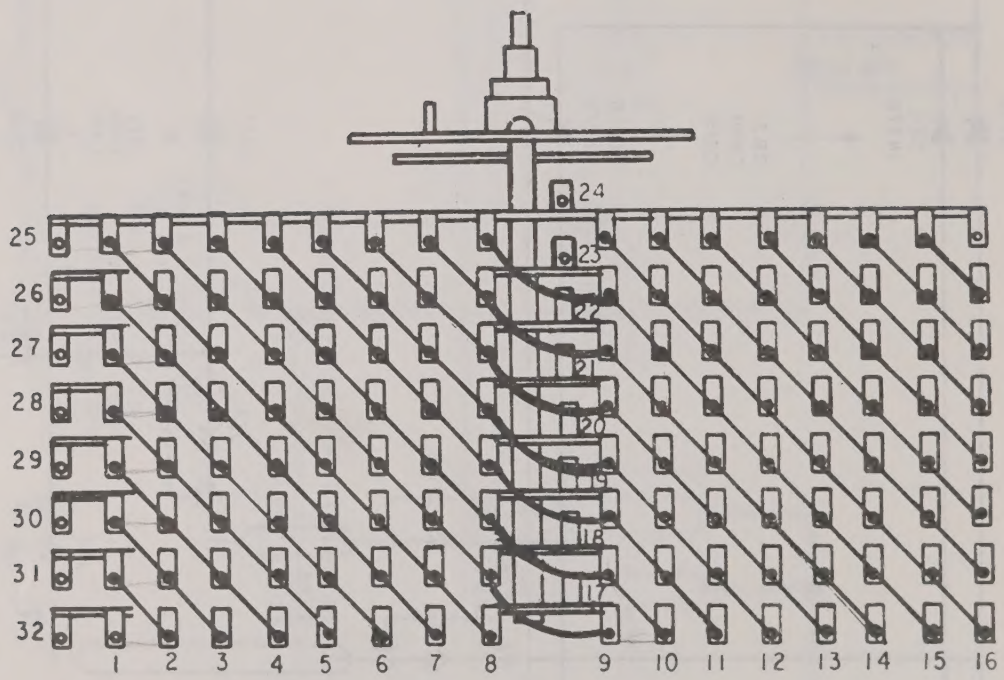

Figure 4. Stepper Switch Wiring Diagram

The VHF and UHF models are identical except for the length of the delay cables, which determines frequency.

An overall view of a typical antenna simulator is shown in figure 5. A photograph of the 16 element switch assembly is shown in figure 6 identifying typical components. A complete parts list is given in table I.

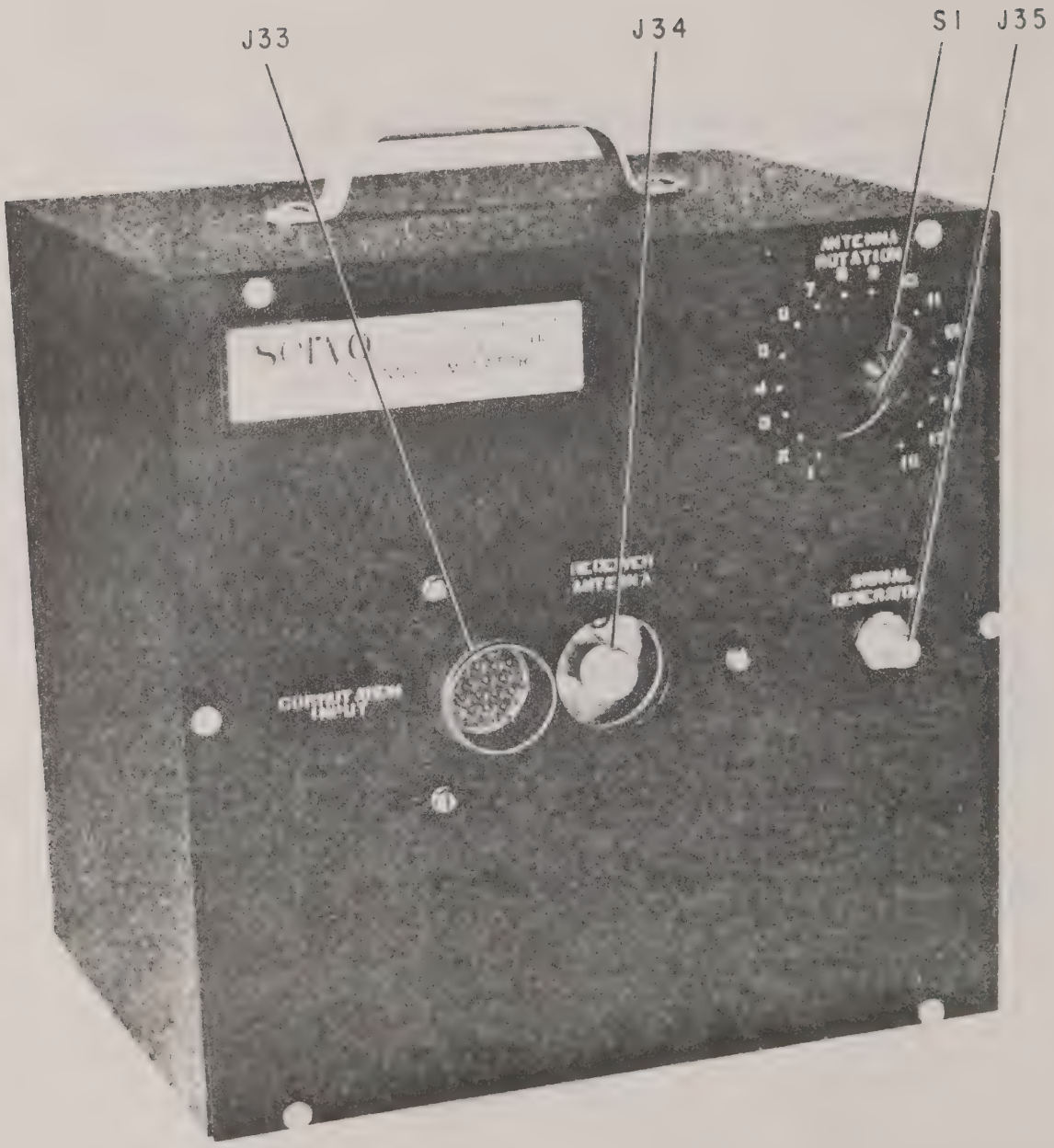

Figure 5. Typical Antenna Simulator

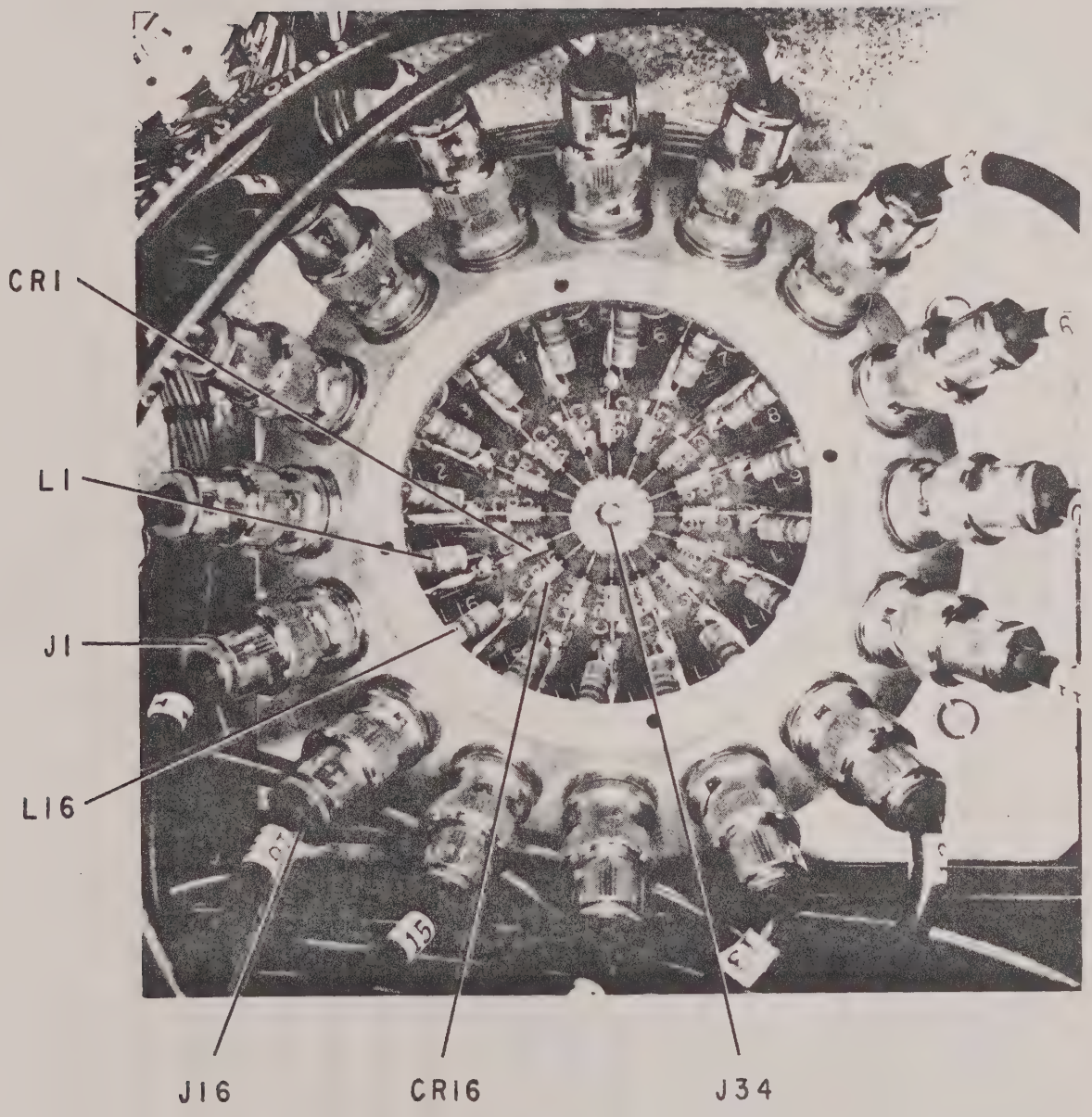

Figure 6. Switch Assembly, 16 element
Location of Components

TABLE I

ASSEMBLY:	VHF ANTENNA SIMULATOR UHF ANTENNA SIMULATOR	P/N 400041-20 P/N 400038-92	SEE FIGURES 5, 6	
REF DESIG	NAME OF PART	SERVO PART NO.	MFR. PART NO.	MFR CODE
	Switch Assy (16 element)	400007-59	-	92110
	Commutator Assy	400008-41	-	92110
	Harness Assy (Includes J33)	400016-75	-	92110
	Distribution Plate Assy	400041-71	-	92110
CR1 - CR32	Diode	015128022	1N270	81349
C1 - C16	Capacitor, feedthru	012218001	FA5C-102W	01121
C17 - C32	Capacitor, .001μf	012208004	CK60AW102M	81349
J1-J32, J35	Connector, receptacle	038006027	UG-1094/U	81349
J34	Connector	300019-23	-	92110
L1 - L16	Choke, 0.22μh	021208001	1537-02	99800
R1-R16, R33	Res, Comp. 51 ohms, 1/2w, 5%	010101032	RC20GF510J	81349
R17 - R32	Res, Comp. 2K ohm, 1/2w, 5%	010101070	RC20GF202J	81349
S1	Switch	300020-51	-	92110
	Cable Assy (RF Test)	400041-75	-	92110
	Cable Assy (Signal Test)	400041-76	-	92110
	Cable Assy (Signal Gen)	400042-14	-	92110

TABLE I (Continued)

ASSEMBLY: DELAY CABLES FOR VHF ANTENNA SIMULATOR P/N 400041-20

REF DESIG	NAME OF PART	SERVO PART NO.	MFR. PART NO.	MFR CODE
	Cable Assy (Delay Cable #1)	200091-21	-	92110
	Cable Assy (Delay Cable #2)	200091-22	-	92110
	Cable Assy (Delay Cable #3)	200091-23	-	92110
	Cable Assy (Delay Cable #4)	200091-24	-	92110
	Cable Assy (Delay Cable #5)	200091-25	-	92110
	Cable Assy (Delay Cable #6)	200091-26	-	92110
	Cable Assy (Delay Cable #7)	200091-27	-	92110
	Cable Assy (Delay Cable #8)	200091-28	-	92110
	Cable Assy (Delay Cable #9)	200091-29	-	92110
	Cable Assy (Delay Cable #10)	200091-30	-	92110
	Cable Assy (Delay Cable #11)	200091-31	-	92110
	Cable Assy (Delay Cable #12)	200091-32	-	92110
	Cable Assy (Delay Cable #13)	200091-33	-	92110
	Cable Assy (Delay Cable #14)	200091-34	-	92110
	Cable Assy (Delay Cable #15)	200091-35	-	92110
	Cable Assy (delay Cable #16)	200091-36	-	92110

TABLE I (Continued)

ASSEMBLY: DELAY CABLES FOR UHF ANTENNA SIMULATOR P/N 400038-92

REF DESIG	NAME OF PART	SERVO PART NO.	MFR. PART NO.	MFR CODE
	Cable Assy (Delay Cable #1)	200091-01	-	92110
	Cable Assy (Delay Cable #2)	200091-02	-	92110
	Cable Assy (Delay Cable #3)	200091-03	-	92110
	Cable Assy (Delay Cable #4)	200091-04	-	92110
	Cable Assy (Delay Cable #5)	200091-05	-	92110
	Cable Assy (Delay Cable #6)	200091-06	-	92110
	Cable Assy (Delay Cable #7)	200091-07	-	92110
	Cable Assy (Delay Cable #8)	200091-08	-	92110
	Cable Assy (Delay Cable #9)	200091-09	-	92110
	Cable Assy (Delay Cable #10)	200091-10	-	92110
	Cable Assy (Delay Cable #11)	200091-11	-	92110
	Cable Assy (Delay Cable #12)	200091-12	-	92110
	Cable Assy (Delay Cable #13)	200091-13	-	92110
	Cable Assy (Delay Cable #14)	200091-14	-	92110
	Cable Assy (Delay Cable #15)	200091-15	-	92110
	Cable Assy (Delay Cable #16)	200091-16	-	92110

TABLE II. LIST OF MANUFACTURERS

CODE	NAME	ADDRESS
01121	Allen Bradley Co.	1201 South 2nd Street Milwaukee, Wisconsin
81349	Military Specifications	Military Dept's/Agencies, under authority of Defense Standardization Manual 4120.3-M
92110	Servo Corporation of America	111 New South Road Hicksville, New York 11802
99800	American Precision Indus.	Delevan Division 270 Quaker Road East Aurora, New York 14502